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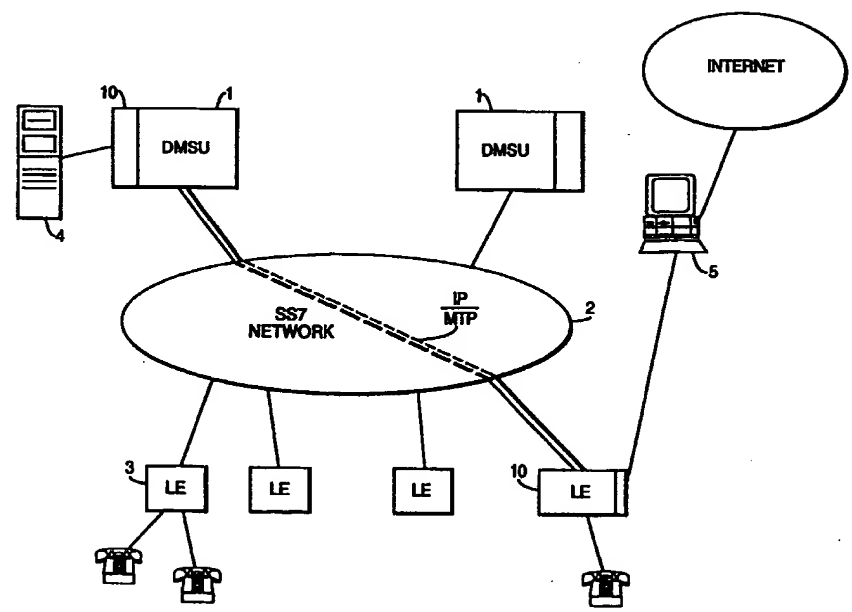
(54) Title: COMMUNICATIONS NETWORK



(57) Abstract

In a communications network, traffic in the form of data conforming to a packet-based internetworking protocol (such as Internet Protocol) is communicated using a circuit switched message signalling protocol (such as MTP (SS7 Message Transport Part)).

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COMMUNICATIONS NETWORK

BACKGROUND TO THE INVENTION

The present invention relates to a communications network, and in particular to a network handling traffic which conforms to a packet-based inter-networking protocol.

Internet Protocol (IP) offers a relatively light-weight and adaptable protocol for data communications and has been widely adopted. Recently, considerable effort has been directed to implementing communications services such as telephony or multimedia conferencing using Internet Protocol. However, the levels of performance it has been possible to achieve hitherto for such applications have been severely limited and fall well below those typically expected, for example, by customers of a conventional PSTN network. An important factor limiting the performance of communication systems using such protocols is that the protocol functions on a "best effort" basis and is not able to offer a guaranteed quality of service. As a result, heavy loading of a network quickly results in delay or loss of packets which in turn severely reduces the quality and intelligibility, for example, of an Internet telephony channel. Attempts to overcome these limitations using supplementary protocols, such as RSVP have not to date been wholly successful.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a method of operating a telecommunications network in which network traffic conforming to a packet-based inter-networking protocol is communicated between network nodes using a circuit-switched messaging protocol, and subsequently the said traffic is transmitted from one of the said network nodes to a customer terminal.

The present invention provides for the first time a method of communicating traffic in a telecommunications network using a hybrid protocol in which data conforming to a packet-based protocol such as Internet protocol is carried over a circuit-switched messaging layer. This approach makes it possible to provide for the traffic the quality of service guarantees needed for successful implementation of services such as internet telephony, whilst maintaining many of the advantages in terms of flexibility and ease of implementation of Internet protocol and other packet-based protocols. Furthermore, this approach greatly

facilitates integration between the communications network and associated computer systems.

The term "traffic" is used here, as is conventional in the field of telecommunications networks, to indicate the signals carrying communications between the end users of the network, e.g. telephone calls, as opposed to any other signals present in the network, such as the control signals conventionally carried on the common channel signalling network, or network management signalling.

Preferably, the packet-based inter-networking protocol is Internet Protocol (IP). Preferably the circuit-switched messaging protocol is a common channel signalling protocol, and more preferably is signalling system number 7 (SS7) MTP (message transport part).

The term "Internet protocol" as used herein encompasses IP version 4 and IP version 6 as defined by the Internet engineering task force (IETF) or any like protocol technically compatible with those protocols. Signalling System number 7 (SS7) is defined by the ITU and is a widely adopted and stable common channel signalling protocol developed for use in telephony networks.

Preferably the method includes steps of receiving data packets conforming to the said packet-based inter-networking protocol, converting addresses carried in the said packets to origination codes and destination codes of a circuit-switched network, and writing the said codes in a signal conforming to the circuit-switched messaging protocol.

This preferred approach to implementing the invention uses, e.g., a look-up table to convert addresses of a packet-based network to corresponding origination and destination codes of a circuit-switched network.

According to another aspect of the present invention, there is provided a method of communicating packet data via a telecommunications network, which telecommunications network includes a circuit-switched signalling network which supports a predetermined messaging protocol, the method including converting the said packet data to a signal conforming to the said predetermined messaging protocol, communicating the converted packet data via the signalling network, and subsequently recovering the packet data from the said signal.

The invention is particularly valuable as a way of using the capabilities of existing telephony networks to support internet traffic.

According to another aspect of the invention, there is provided a node including means for converting data conforming to a packet-based internetworking protocol to a format conforming to a circuit-switched signalling protocol, and means for outputting a signal in the said format onto a communications network.

The node may be a trunk or exchange switch, as in the example described below, or may be an edge-of-network terminal such as a personal computer, an intelligent telephone or a mobile Java terminal.

BRIEF DESCRIPTION OF THE DRAWINGS

Systems embodying the present invention will now be described in further detail, by way of example only, with respect to the accompanying drawings, in which:

Figure 1 is a schematic showing a communications network embodying the invention;

Figure 2 shows a protocol stack for a system embodying the invention;

Figure 3 shows a look-up table used in the IP/MTP layer of Figure 2;

Figures 4 to 15 are SDL diagrams for a system embodying the invention;

Figure 16 shows a signal communicated in IP over MTP format via an intermediate node.

DESCRIPTION OF EXAMPLES

A telecommunications network includes a number of digital main switch units (DMSU's) 1 which are connected by a common channel signalling network 2 to each other and to local exchanges 3. Each trunk exchange and at least some of the local exchanges include a data interface 10. In the example illustrated in the Figure, the data interface of one of the DSMU's is connected to a data server 4. This data server might be used, for example, to source a packetised MPEG-encoded video data stream in an internet video-on-demand (VoD) application. A data terminal, 5, which may be a personal computer, is connected to the data interface of one of the local exchanges.

In use, the data server transmits data, such as VoD programme material, as Internet Protocol (IP) packets to the data interface of the DMSU. The data packets carry, in this example, the internet address of the data terminal. Within the DMSU, the data packets are processed within an IP/MTP convergence layer for transmission over the common channel signalling network using SS7 Message Transfer Part protocol. The converted packets are then carried within the

signalling network to the local exchange. Here, the convergence layer carries out a complementary function, converting data from the MTP layer into IP packets for forwarding to the customer data terminal.

Figure 2 shows the IP over MTP protocol stack of the system described above. The IP/MTP convergence layer carries out functions of address mapping, signalling link selection, encapsulation of IP messages and support of relevant MTP primitives.

The address mapping function converts IP addresses to MTP point codes and vice versa. In the present example, this done using a look-up table, as illustrated in Figure 3. This converts the source and destination IP addresses to originating point code (OPC) and destination point code (DPC) respectively. A service indicator in the MTP SIO field is set to identify IP as the MTP user.

The convergence layer is also responsible for selecting the signalling link within the SS7 network to be used in conveying the data, and indicates this selection to the MTP layers. The MTP makes use of this indication in selecting a physical link for transmission, although the MTP logic may choose a different link in the selection indicated is unavailable. The step of selecting the signalling link by the convergence layer may be carried out, for example, by stepping round a cycle of all possible link numbers, with a new link selected for each IP packet, other than when an IP packet is fragmented, in which case the fragmented packets are sent on the same link to ensure a high probability that the packets are received in the correct order.

IP messages are encapsulated in the signalling information field SIF of an MTP Message Signal Unit (MSU), immediately following an MTP level routing label. The IP message is sent to MTP level 3 in an *MTP-transfer* primitive. The size of the IP message needs to be less than or equal to 268 octets. IP messages longer than this are fragmented by the IP layer. The MTP layers of the system are required to support SIFs of 272 octets in order to accommodate the IP message and an MTP level 3 routing label.

The IP / MTP convergence layer supports the following MTP level 3 primitives:

Primitive Name	Primitive Type	Parameters

MTP-transfer	request, indication.	originating point code (OPC), destination point code (DPC), signalling link selection (SLS), service information octet (SIO), user data (IP message).
MTP-pause	indication.	destination point code (DPC).
MTP-resume	indication.	destination point code (DPC).
MTP-status	indication.	destination point code (DPC), cause.
MTP-restart	indication.	destination point codes DPC

The MTP-transfer request and indication primitives are used to transmit and receive, respectively, IP messages to and from the remote host. The point code of the remote host is given by the DPC parameter. The OPC parameter indicates the point code of the originating the message. The SLS and SIO will be selected as described above. The User Data part of the primitive will contain the IP message.

On receipt of an MTP-pause indication, the inability of the MTP to communicate with its peer (with point code indicated by the parameter DPC) is indicated to the IP layer, and any messages requested by IP to be sent to that DPC will be discarded. On receipt of an MTP-resume, the ability of the MTP to communicate with its peer (with point code indicated by the parameter DPC) is indicated to the IP layer, and any messages requested by IP to be sent to that DPC will be transmitted.

On receipt of an MTP-status indicating user part unavailability at the remote host with point code DPC, the inability to deliver messages is indicated to the IP layer, and any messages requested by IP to be sent to that DPC will be discarded. On receipt of an MTP-status with a cause parameter indicating congestion at the remote host with point code DPC, congestion controls (for further study) will be imposed on all messages to be sent to the peer user part at that DPC, appropriate for the level of congestion, until the congestion has ceased.

Receipt of an MTP-restart indication indicates that an MTP restart has occurred, and is handled appropriately by marking that specific previously unavailable locations are now available.

While for the example illustrated in Figure 1, the IP over MTP connection passes in a single hop between originating and destination, in general a connection may pass through one or more intermediate stages. Figure 16 shows a connection from originating node A to destination node C passing via intermediate node B. As shown in the Figure, at the intermediate node, the message makes a double pass through the convergence layer, in the course of which the destination point code of the incoming message becomes the origination point code of the outgoing message.

Figures 4 to 15 are SDL (Specification Description Language) diagrams illustrating an implementation of the system described above. These may be compiled using commercially available tools to provide the basis of the software required to implement the convergence layer. Figure 4 is a system diagram showing the IP and MTP bidirectional links to and between exchanges. Figure 5 formally indicates that the behaviour of the terminating exchange is the same as the originating exchange. Figure 6 shows messages to and from the IP/MTP convergence process and the relationship with IP and MTP processes. Figure 7 defines the behaviour of the IP/MTP conversion process. Figure 8 is a continuation of Figure 7. Figure 9 shows a procedure to check whether required DPC is marked as congested. Figure 10 shows a procedure to check whether a required DPC is marked unavailable. Figure 11 shows a congestion control procedure to mark destination point codes as congested when notified by the MTP process and to perform required congestion control. Figure 12 shows a DPC available procedure to remove any DPC codes marked as unavailable which the MTP process has indicated as now being available. Figure 13 shows a DPC unavailable procedure to mark DPC unavailable when so indicated by the MTP process. Figure 14 shows a procedure to find an appropriate signalling link. Figure 15 is a look-up procedure to translate a received IP address into the origination and destination codes required by MTP.

CLAIMS

1. A method of operating a telecommunications network in which network traffic conforming to a packet-based inter-networking protocol is communicated between network nodes using a circuit-switched messaging protocol, and subsequently the said traffic is transmitted from one of the said network nodes to a customer terminal.

2. A method of operating a telecommunications network, which telecommunications network includes a circuit-switched message signalling network connecting a plurality of network exchanges, which signalling network supports a messaging protocol, the method including:

receiving packet data;

converting the said packet data to a signal conforming to the said messaging protocol,

communicating the converted packet data via the signalling network to a network exchange;

at the network exchange subsequently recovering the packet data from the said signal; and

transmitting the packet data from the exchange to a customer terminal

3. A method according to claim 1 or 2, in which the packet-based inter-networking protocol is Internet Protocol (IP).

4. A method according to any one of claims 1 to 3, in which the circuit-switched message signalling protocol is a common channel signalling protocol,

5. A method according to claim 4, in which the circuit-switched message signalling protocol is signalling system number 7 (SS7) message transport part (MTP).

6. A method according to any one of the preceding claims, including steps of receiving data packets conforming to the said packet-based inter-networking protocol, converting addresses carried in the said packets to origination codes or

destination codes of a circuit-switched network, and writing the said codes in a signal conforming to the circuit-switched message signalling protocol.

7. A node for connection in a communications network and adapted for use in a method according to any one of claims 1 to 6.

8. A node for use in a method according to any one of claims 1 to 6 including means for receiving traffic comprising data conforming to a packet-based internetworking protocol, means for converting the data conforming to a packet-based internetworking protocol to a format conforming to a circuit-switched signalling protocol, and means for outputting a signal in the said format onto a communications network.

9. A telecommunications network including a node according to claim 8.

10. A telecommunications network comprising:

a plurality of network exchanges;
a signalling network interconnecting the plurality of exchanges;
access networks connected to the plurality of exchanges;
at least one of the plurality of exchanges including:

a traffic interface arranged to receive traffic comprising data conforming to a packet-based internetworking protocol from a respective one of the access networks;
a converter connected to the traffic interface and arranged to convert the data conforming to a packet-based internetworking protocol to a format conforming to a circuit-switched signalling protocol: and
a signalling network interface connected to the converter and arranged to output the said data onto the signalling network.

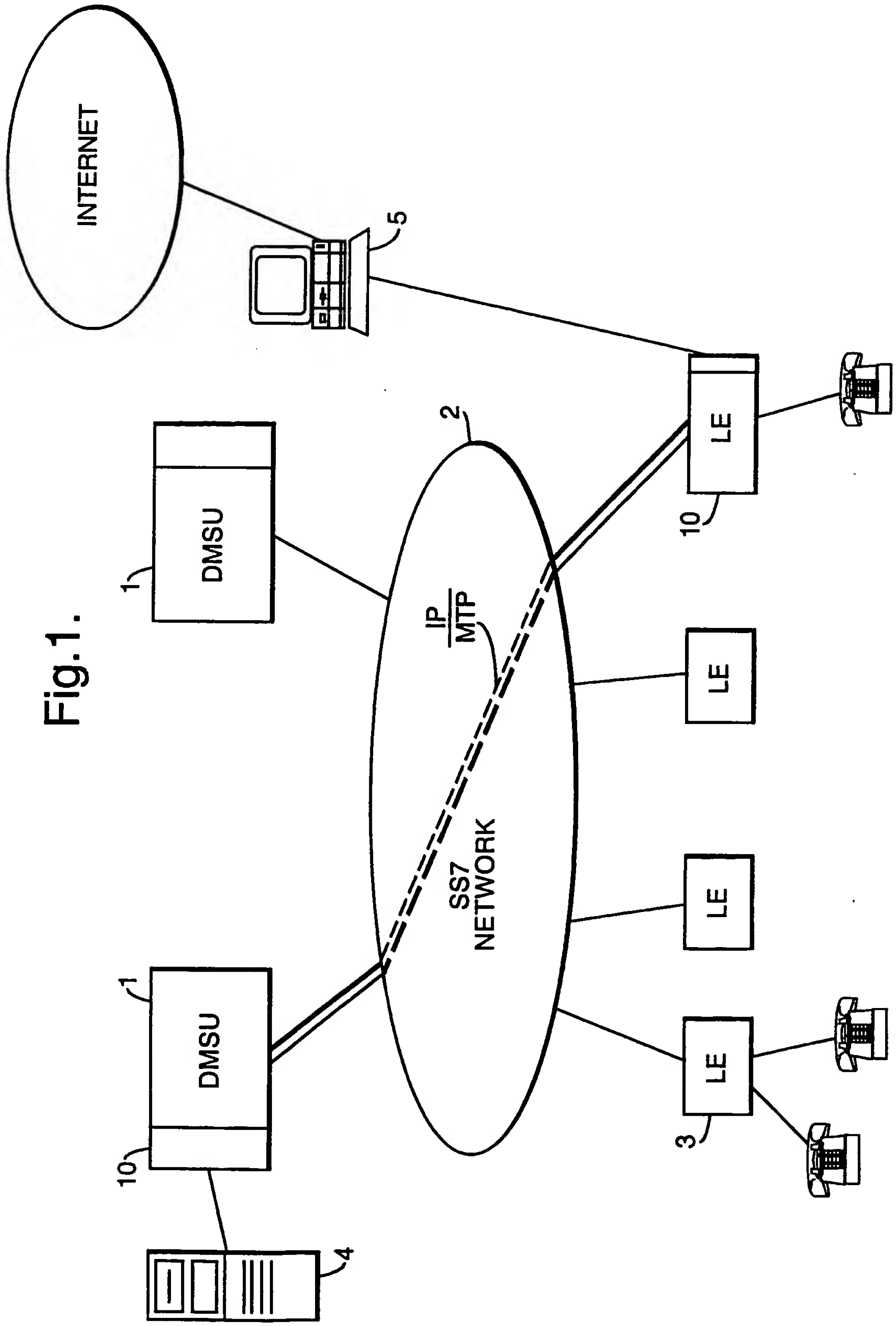


Fig.1.

Fig.2.

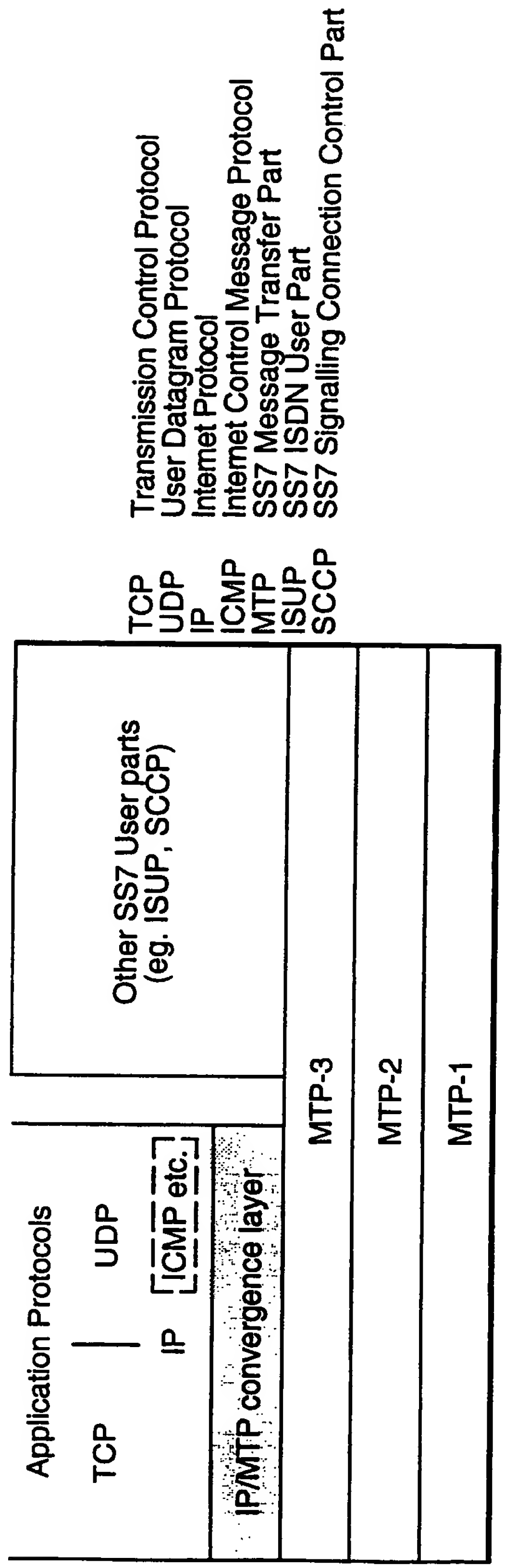

Application Protocols
TCP
UDP
IP
ICMP etc.
IP/MTP convergence layer
Other SS7 User parts (eg. ISUP, SCCP)
MTP-3
MTP-2
MTP-1
TCP Transmission Control Protocol
UDP User Datagram Protocol
IP Internet Protocol
ICMP Internet Control Message Protocol
MTP SS7 Message Transfer Part
ISUP SS7 ISDN User Part
SCCP SS7 Signalling Connection Control Part

Fig.3.

IP Addr	OPC	DPC
123.1.123...	14	17
123.2.123...	15	18

Fig.4.

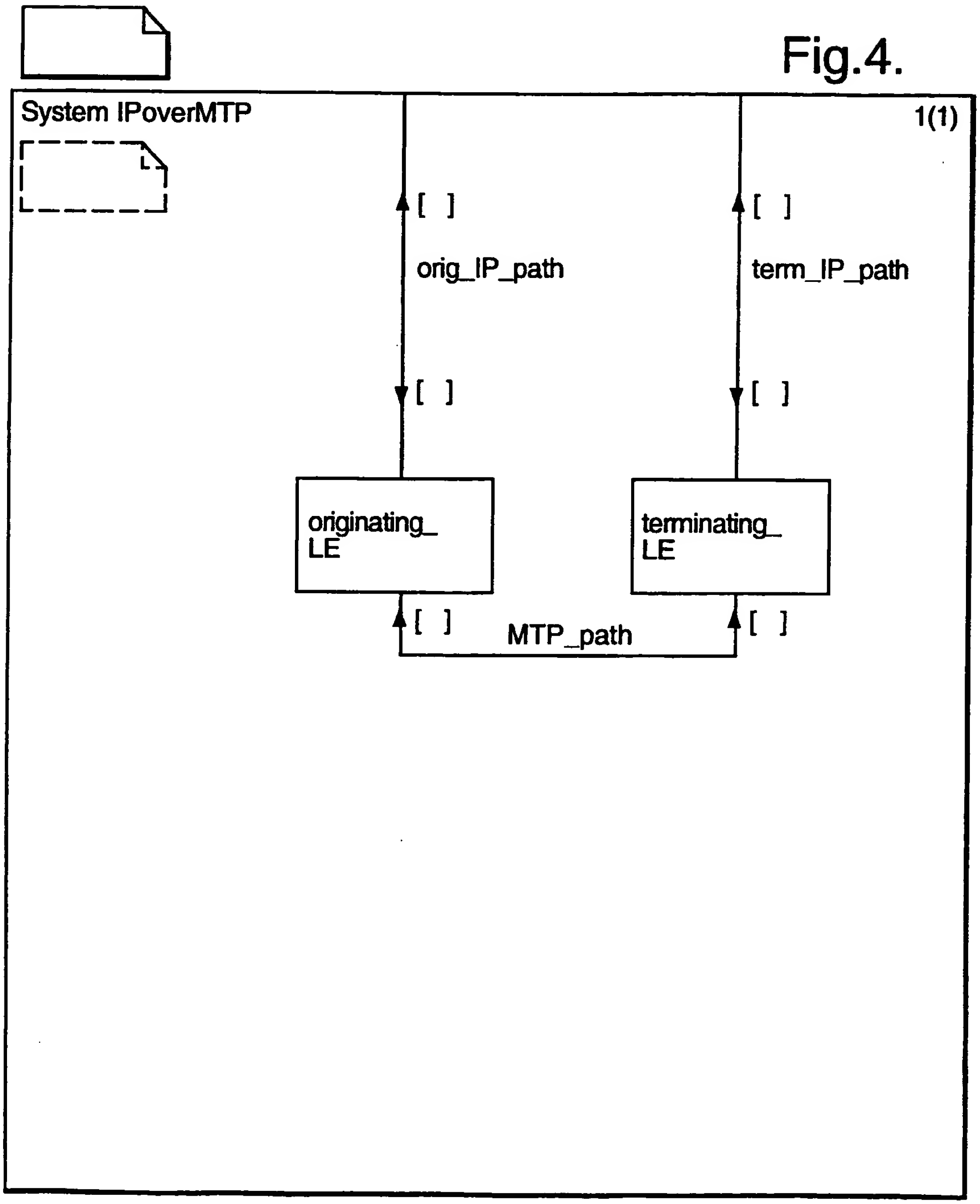


Fig.5.

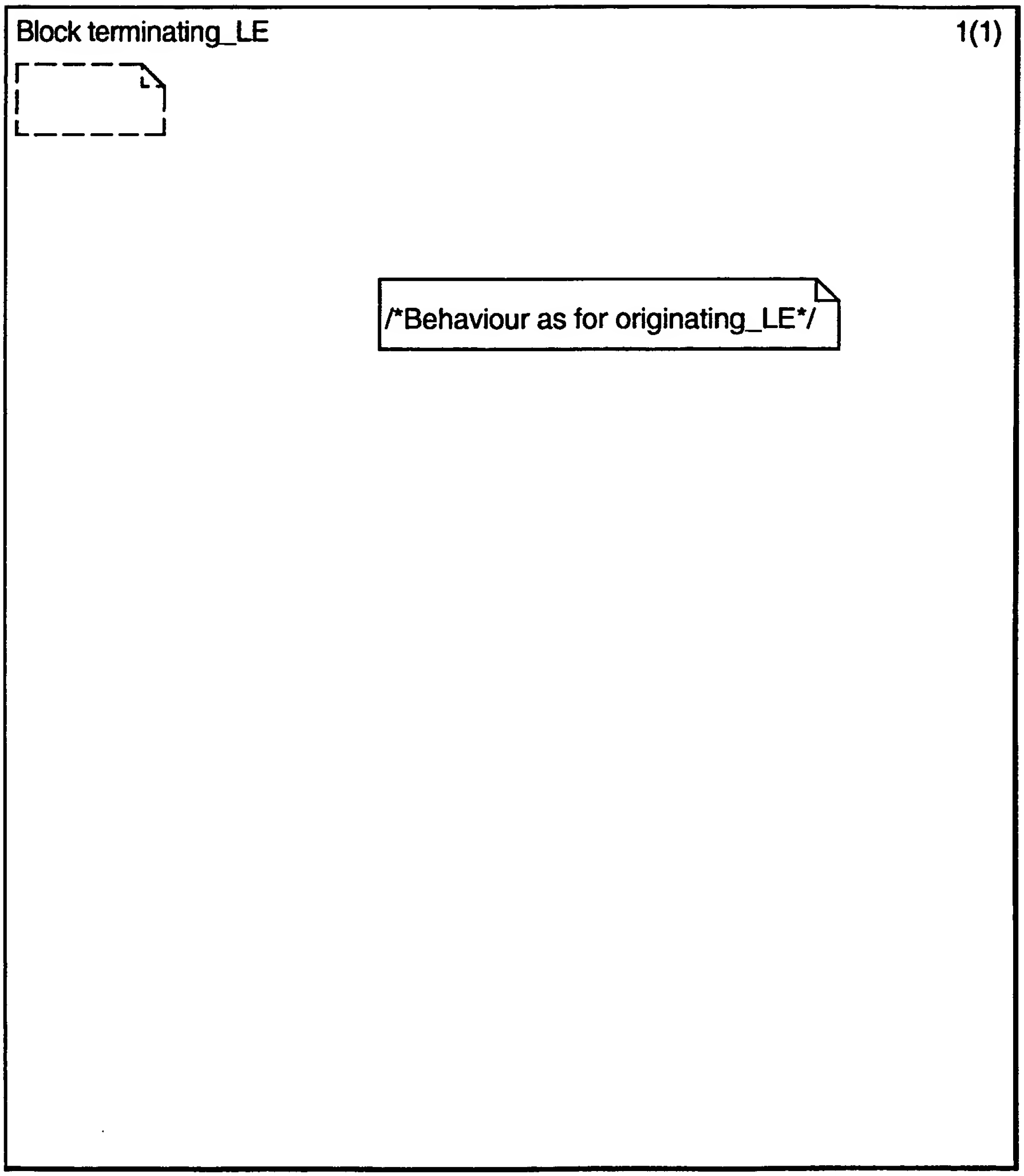


Fig.6.

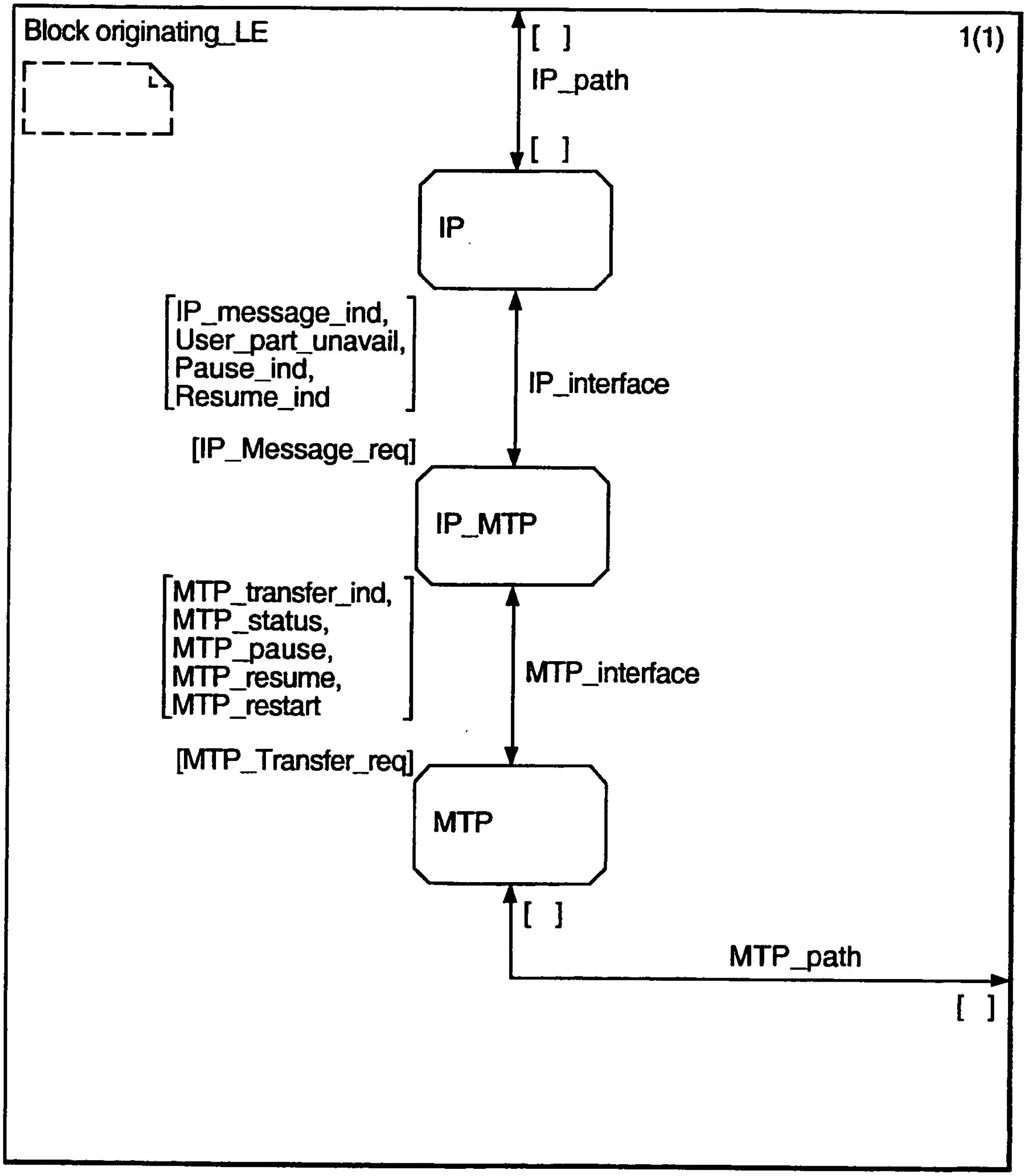
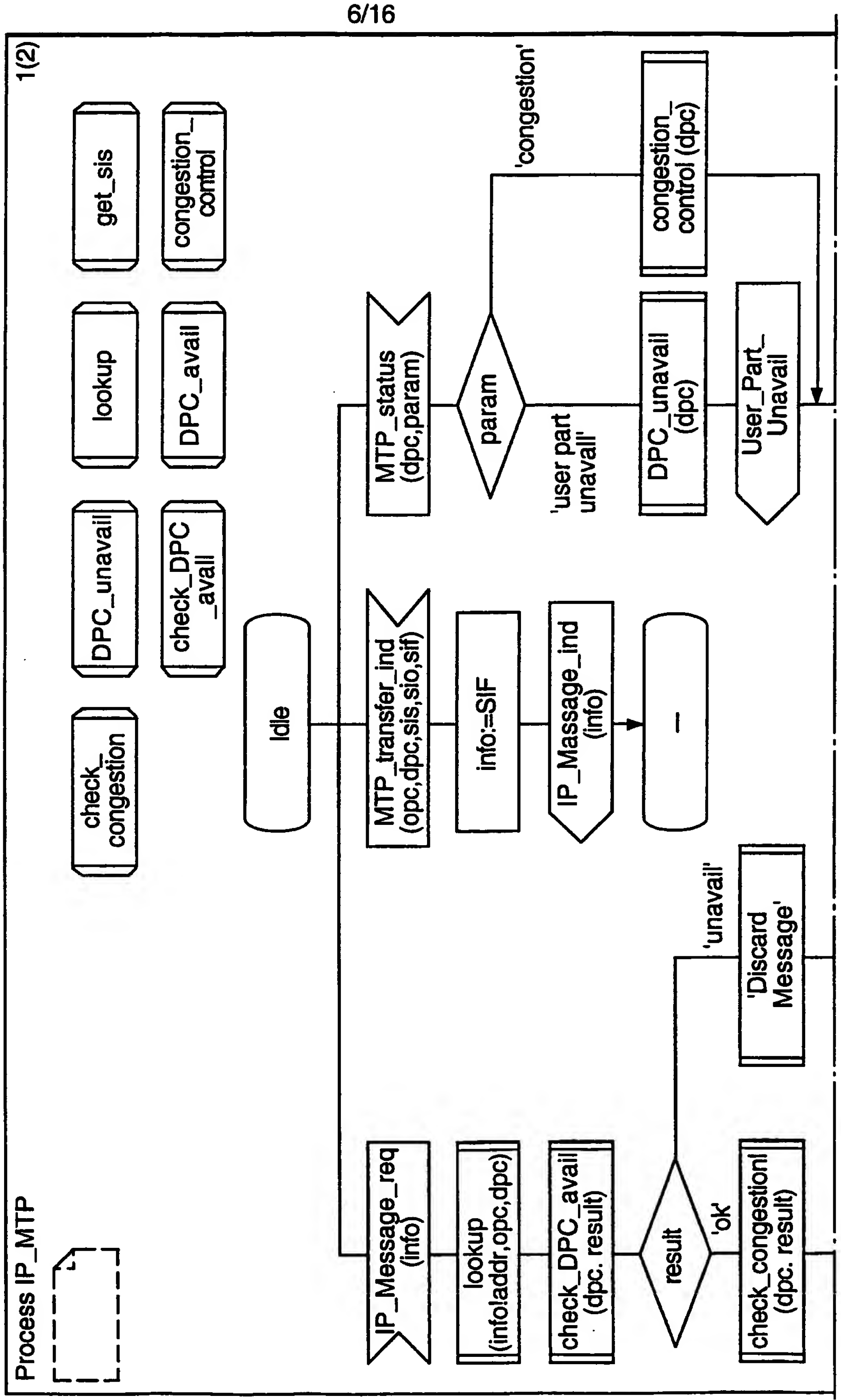

Block originating_LE
1(1)
[ ]
IP_path
[ ]
IP
[IP_message_ind,
User_part_unavail,
Pause_ind,
Resume_ind]
IP_interface
[IP_Message_req]
IP_MTP
[MTP_transfer_ind,
MTP_status,
MTP_pause,
MTP_resume,
MTP_restart]
MTP_interface
[MTP_Transfer_req]
MTP
[ ]
MTP_path
[ ]

Fig.7.


Process IP_MTP
1(2)
check_ congestion
DPC_unavail
lookup
get_sis
check_DPC _avail
DPC_avail
congestion_ control
Idle
MTP_transfer_ind (opc,dpc,sis,sio,sif)
info:=SIF
IP_Massage_ind (info)
–
MTP_status (dpc,param)
param
'congestion'
congestion_ control (dpc)
'user part unavail'
DPC_unavail (dpc)
User_Part_ Unavail
IP_Message_req (info)
lookup (infoladdr,opc,dpc)
check_DPC_avail (dpc. result)
result
'unavail'
'Discard Message'
'ok'
check_congestionl (dpc. result)

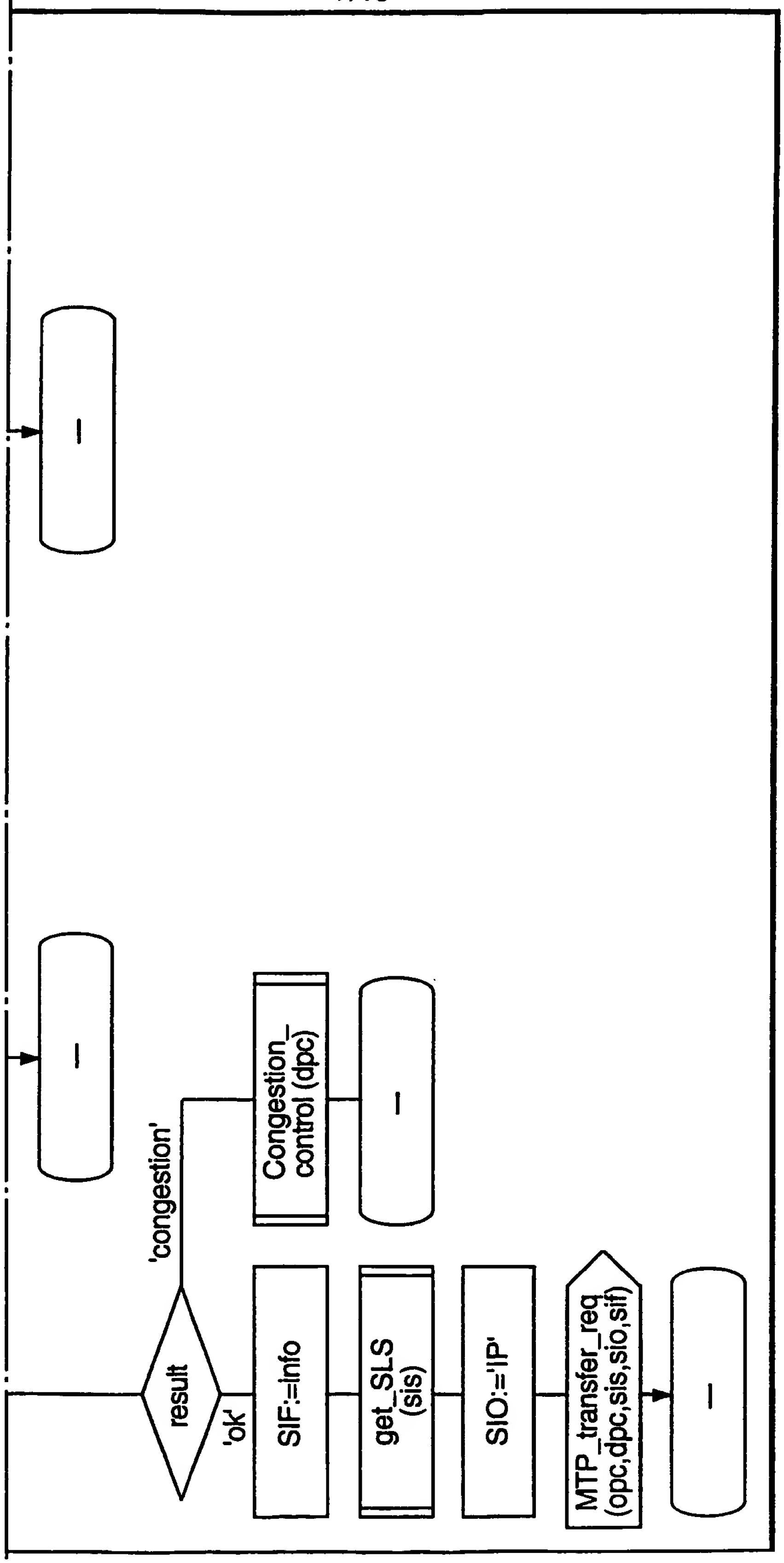

result
'ok'
'congestion'
Congestion_
control (dpc)
SIF:=info
get_SLS
(sis)
SIO:='IP'
MTP_transfer_req
(opc,dpc,sis,sio,sif)

Fig.7(Cont).

Fig.8.

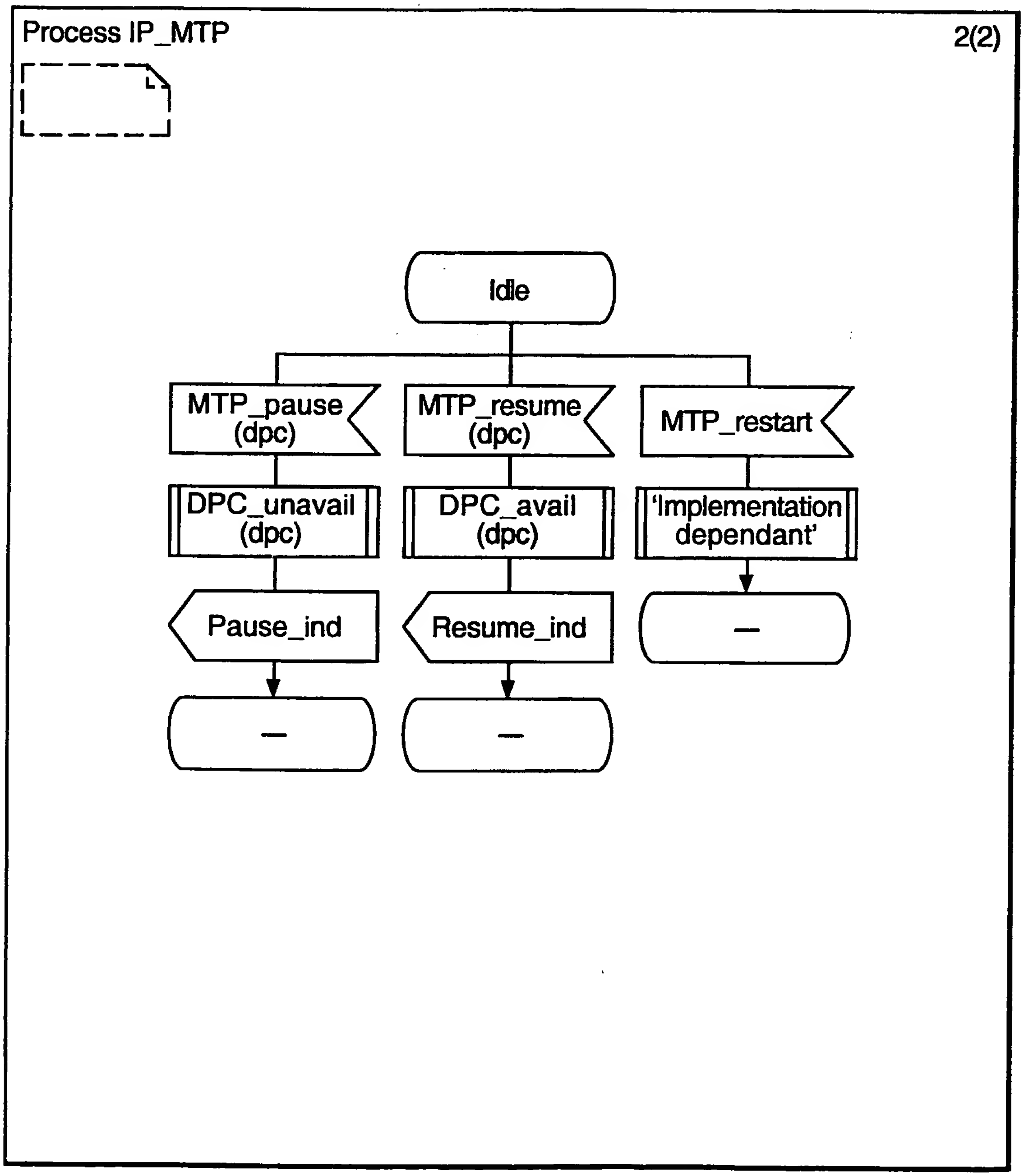

Process IP_MTP
2(2)
Idle
MTP_pause (dpc)
MTP_resume (dpc)
MTP_restart
DPC_unavail (dpc)
DPC_avail (dpc)
'Implementation dependant'
Pause_ind
Resume_ind
—
—
—

Fig.9.

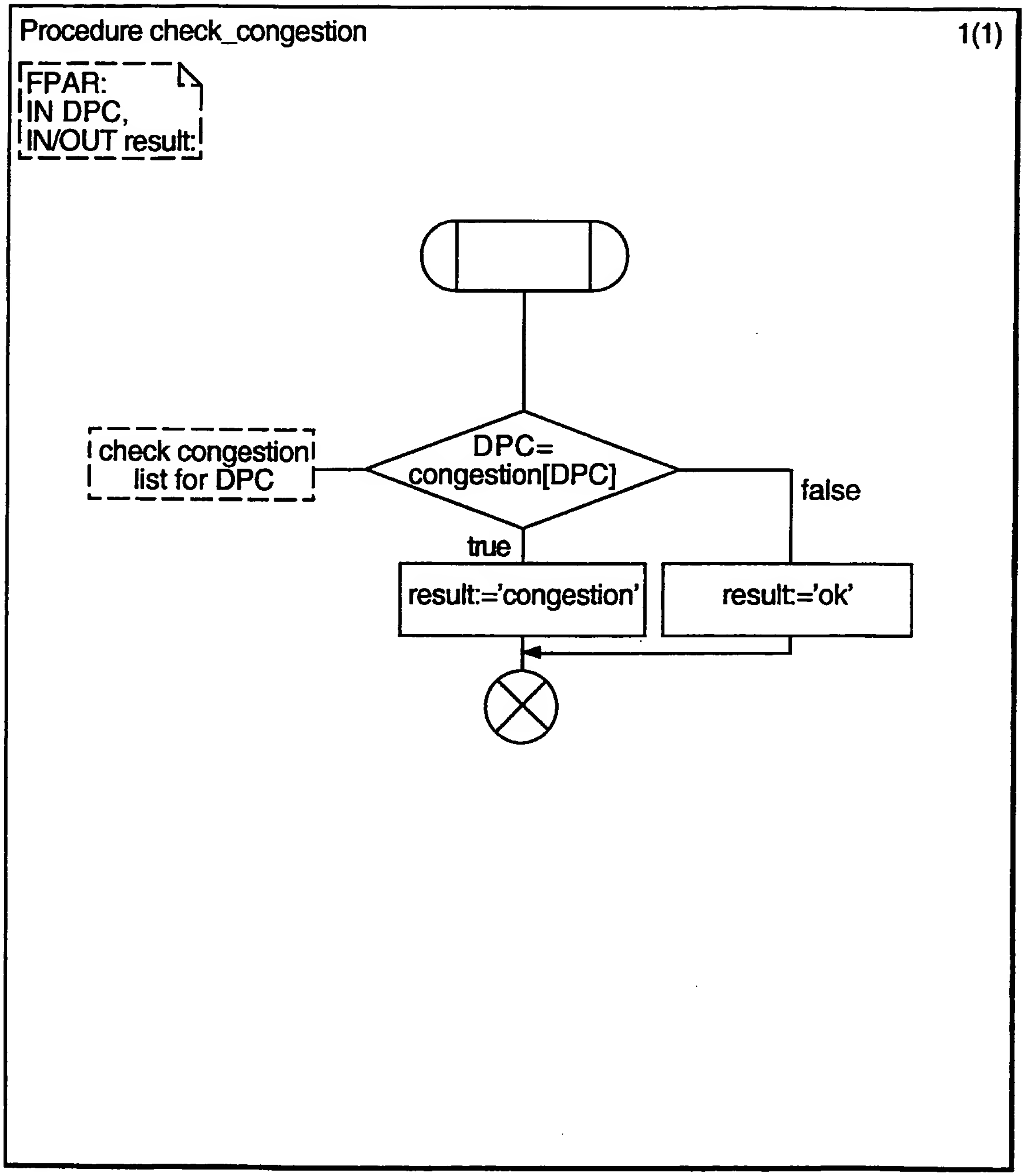

Procedure check_congestion
1(1)
FPAR:
IN DPC,
IN/OUT result:
check congestion
list for DPC
DPC=
congestion[DPC]
false
true
result:='congestion'
result:='ok'

Fig.10.

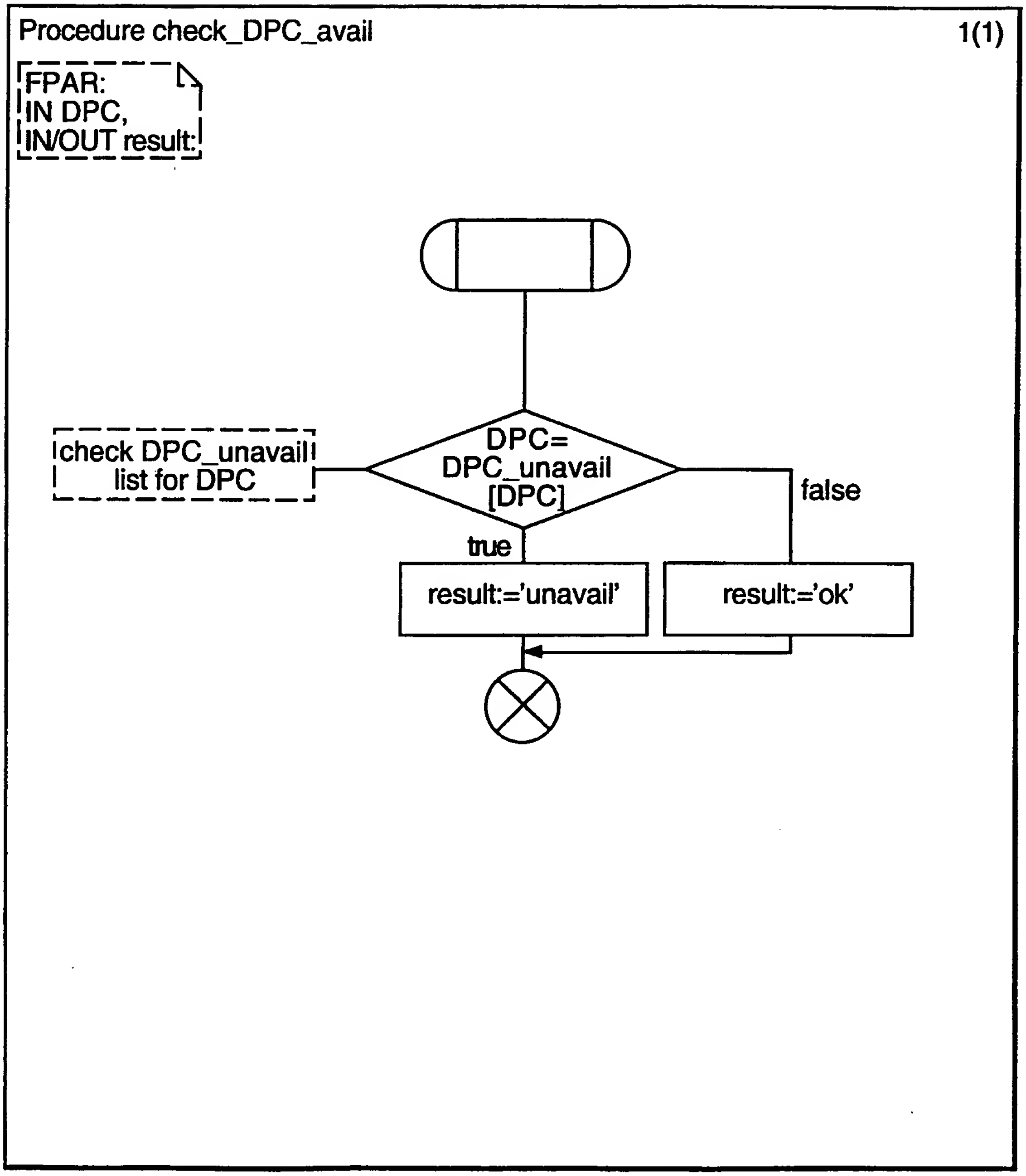

Procedure check_DPC_avail
1(1)
FPAR:
IN DPC,
IN/OUT result:
check DPC_unavail list for DPC
DPC=
DPC_unavail
[DPC]
true
false
result:='unavail'
result:='ok'

Fig.11.

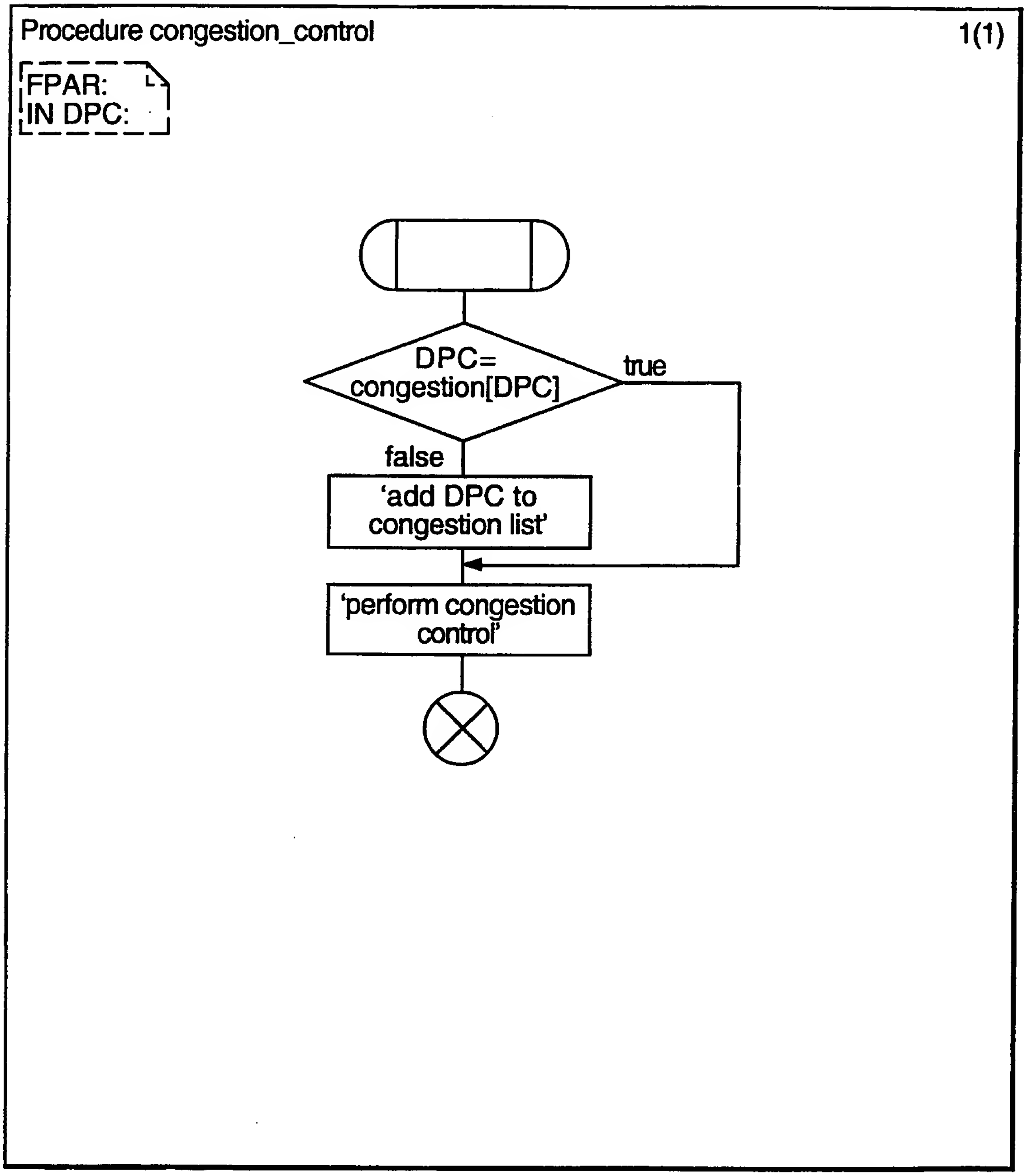

Procedure congestion_control
1(1)
FPAR:
IN DPC:
DPC=
congestion[DPC]
true
false
'add DPC to
congestion list'
'perform congestion
control'

Fig.12.

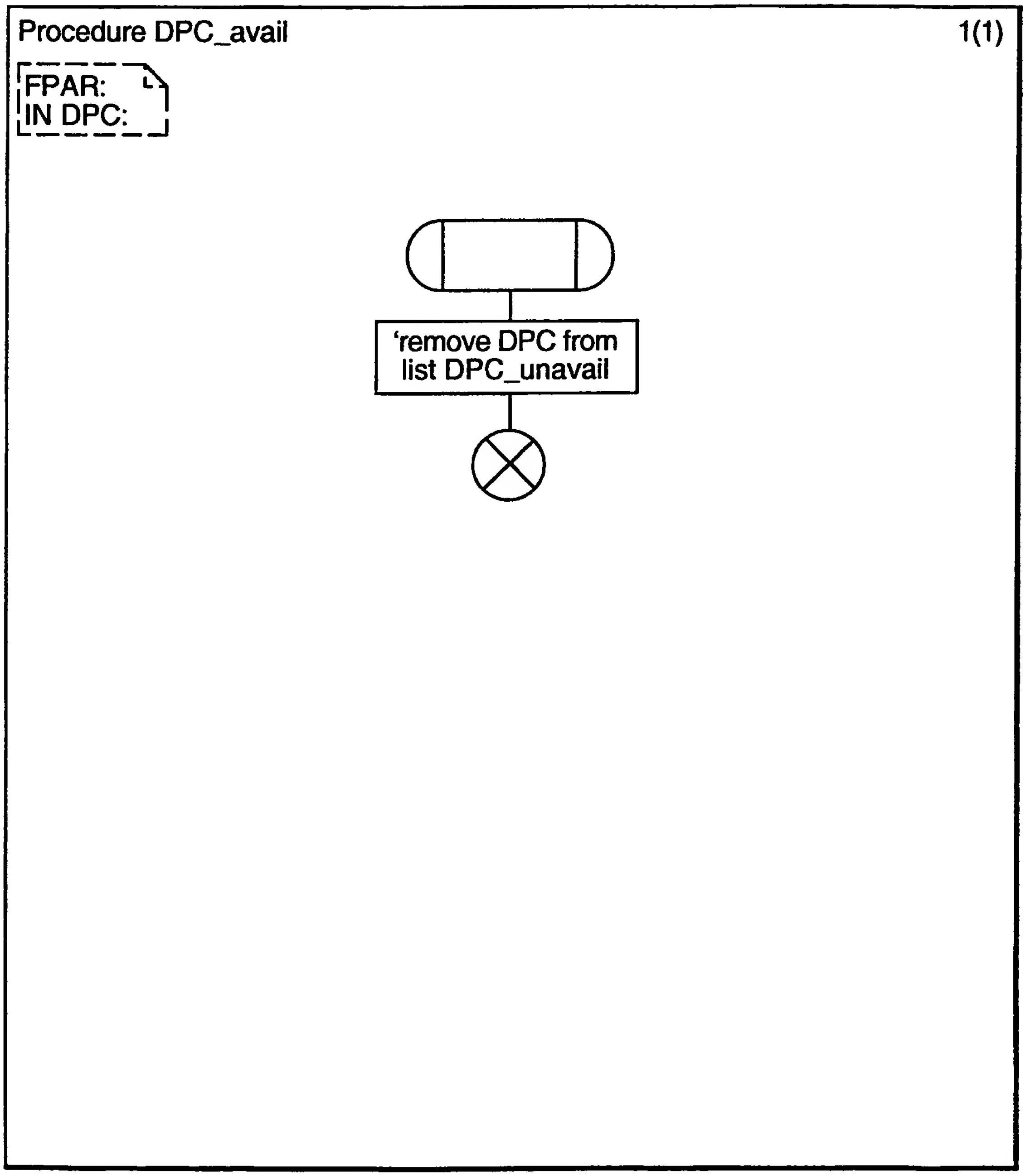

Procedure DPC_avail
1(1)
FPAR:
IN DPC:
'remove DPC from
list DPC_unavail

Fig.13.

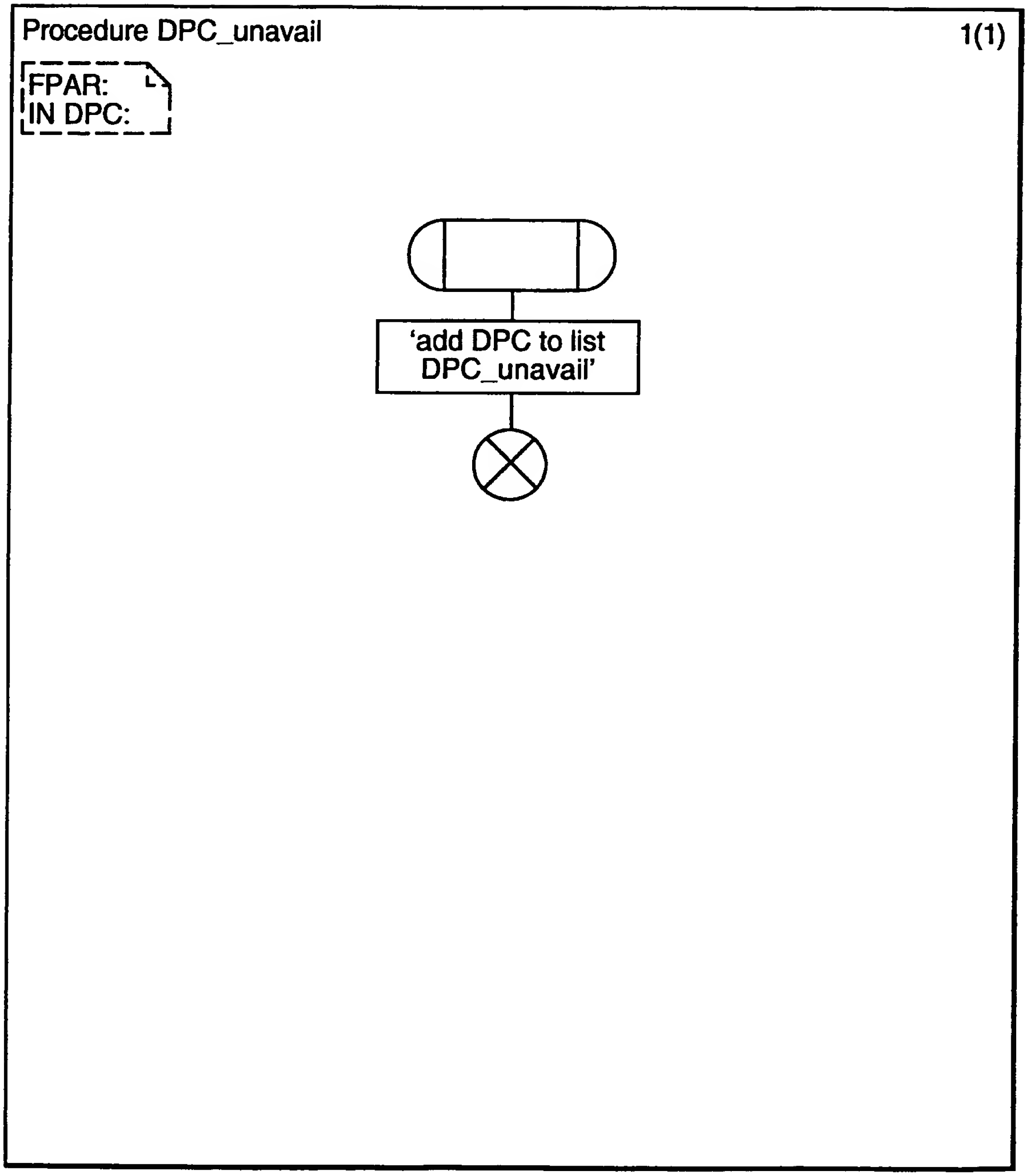

Procedure DPC_unavail
1(1)
FPAR:
IN DPC:
'add DPC to list
DPC_unavail'

Fig.14.

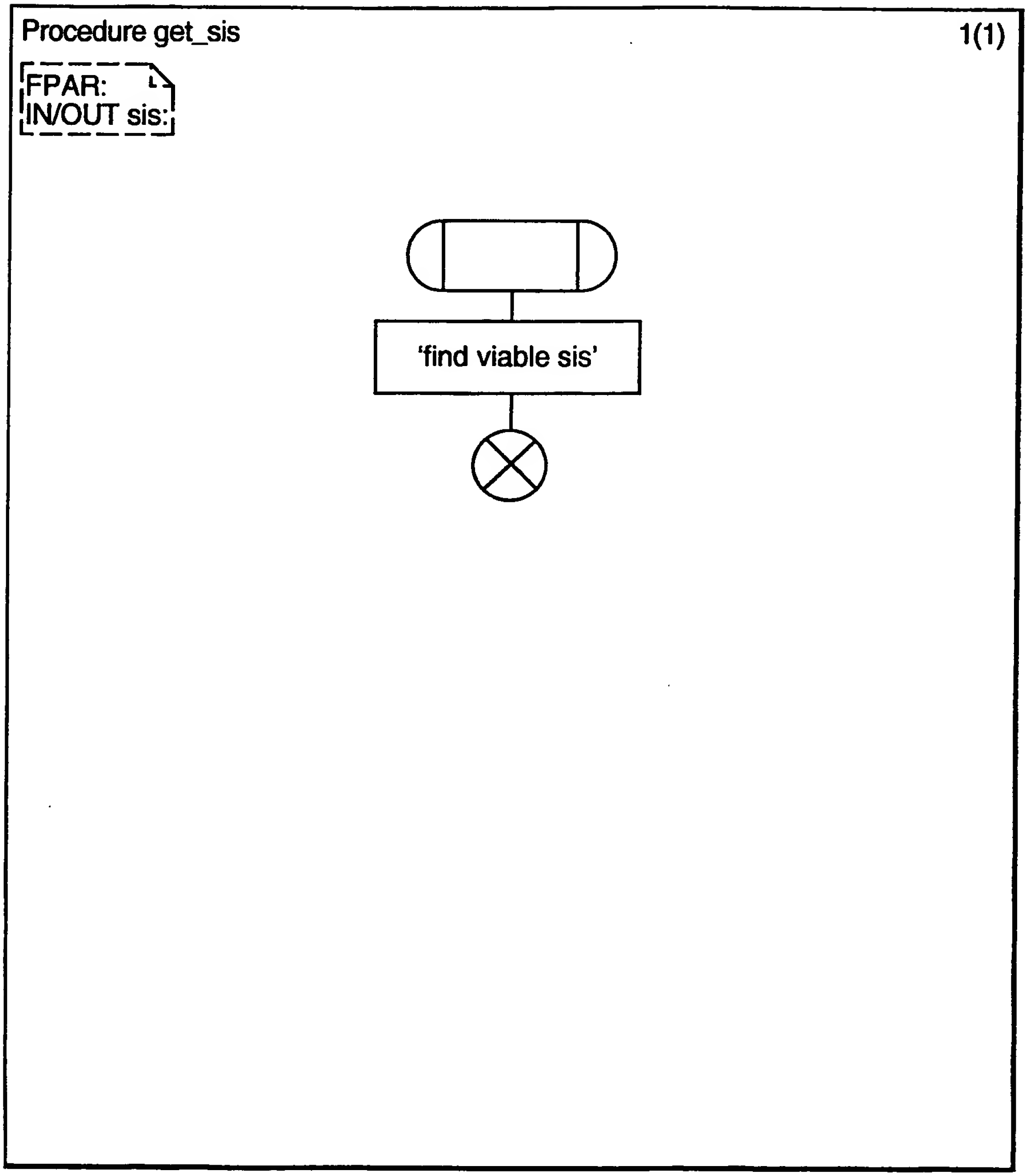


Fig.15.

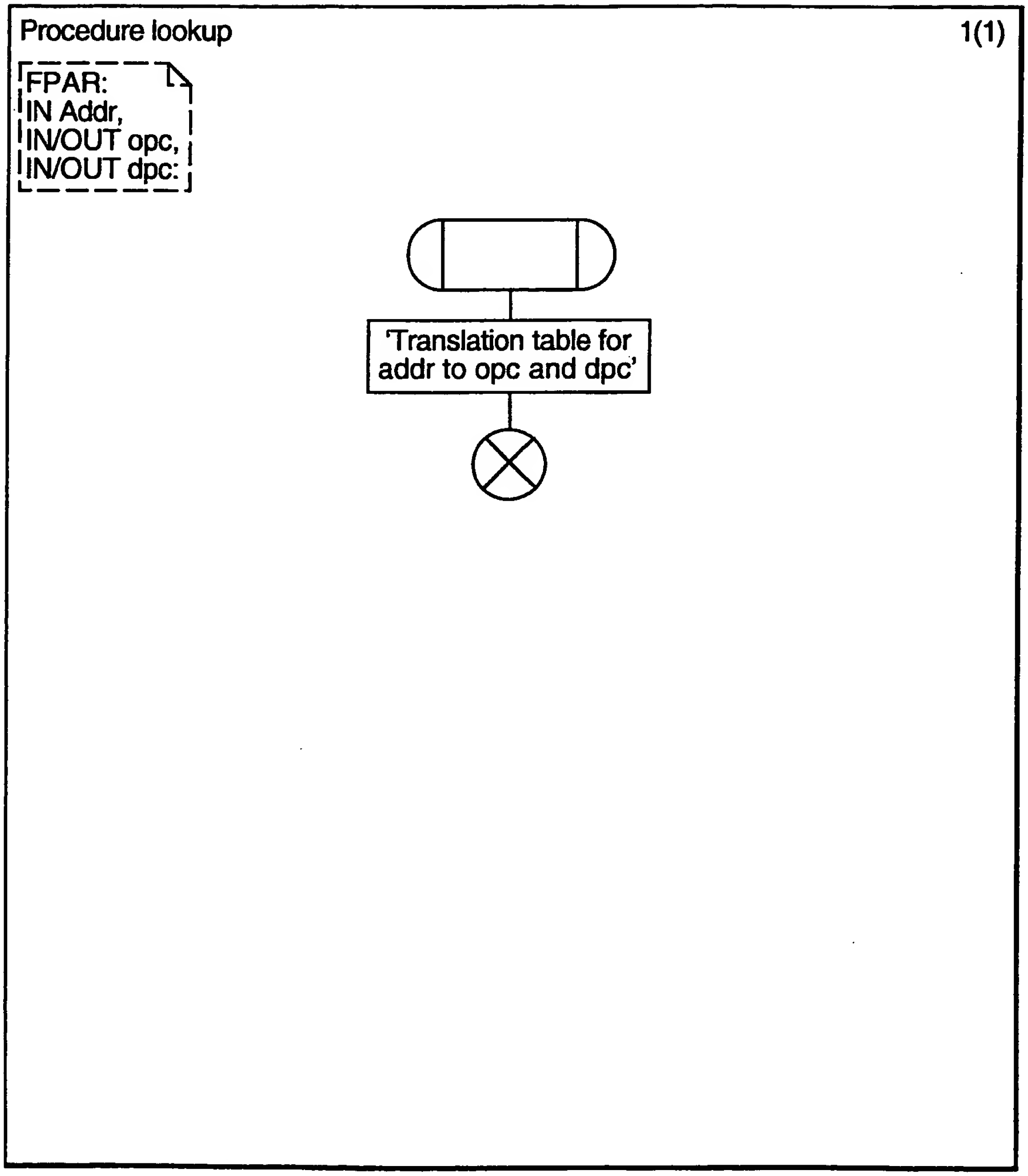
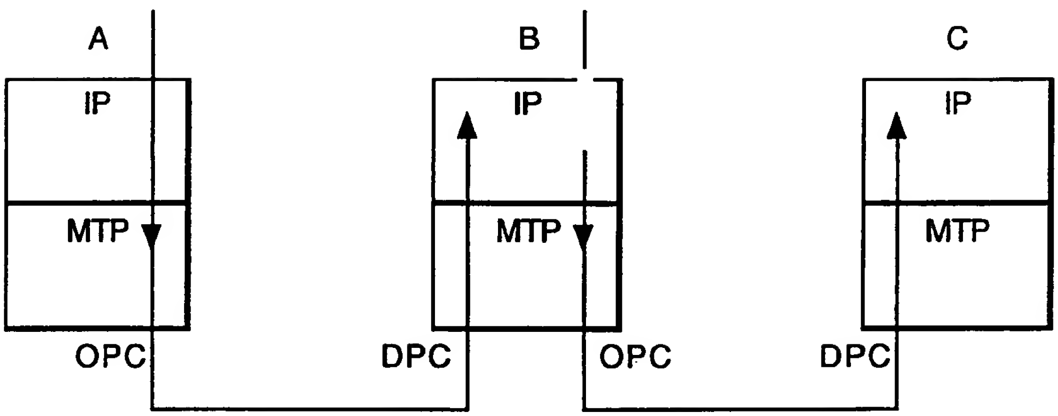

Procedure lookup
1(1)
FPAR:
IN Addr,
IN/OUT opc,
IN/OUT dpc:
'Translation table for
addr to opc and dpc'

Fig.16.



INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/00817

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04L29/06 H04Q3/00 H04L12/66

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04Q H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97 42774 A (ERICSSON TELEFON AB L M) 13 November 1997 (1997-11-13) page 4, line 8 - page 6, line 16; figures 3,4	1,2,7-10
A	WO 96 34504 A (ERICSSON TELEFON AB L M ;DAHLIN JAN ERIK AAKE STEINAR (SE); CHAMBE) 31 October 1996 (1996-10-31) page 3, line 3-26 page 6, line 1-28 page 8, line 1 - page 11, line 3	10

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